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# DIVIDENDS FROM WOOD RESEARCH

## Recent Publications

July - December 1984

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### list of categories

Publications are listed in this brochure within the following general categories:

- Adhesives
- Anatomy and properties
- Buildings and construction
- Chemistry
- Degradation and protection
- Design data
- Economics
- Fire
- General
- Mycology
- Packaging
- Processing (drying, machining, sawing, gluing, grading)
- Pulp and paper

### adhesives

#### **1. Effect of Ventilation Rate and Board Loading on Formaldehyde Concentration: A Critical Review of the Literature**

Myers, George E.  
Forest Prod. J. 34(10): 59-68; 1984.

This paper is the second in a series and deals specifically with effects of ventilation rate and board loading (board area exposed within a certain air volume) on formaldehyde concentrations in air that are produced by particleboard and plywood paneling. As with the first critique, the present one is based on a bibliography derived from a search of several sources covering the period from 1960 through February 1983.

#### **2. Method for Evaluating Nonrigid Adhesives for Use in Structural Joints**

River, Bryan H.  
J. Appl. Polym. Sci.: Appl. Polym. Symp. 40, 235-250; 1984.

In this study, a method developed for measuring the stress-strain-time relationships of plastics in tension was applied to the stress-strain-time relations of adhesives in shear. Then the method was extended to develop a temperature-moisture relationship for the shear stress-strain properties of adhesives. Results obtained with four nonrigid adhesives are described and discussed.



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## **anatomy and properties**

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### **3. Evaluation of the Tensor Polynomial Strength Theory for Wood**

Liu, J. Y.  
J. Compos. Mater. 18: 216-226; 1984.

The tensor polynomial (Tsai-Wu) strength theory with the interaction stress coefficient,  $F_{12}$ , determined from the Hankinson formula, has been applied in this study to predict the strength of wood under plane-stress conditions. Since the Hankinson formula has been verified repeatedly and has been popular in the wood industry, it is recommended that  $F_{12}$  be based on the Hankinson formula.

### **4. Shear Strength in Principal Plane of Wood**

Liu, Jen Y.; Floeter, Lester H.  
J. Eng. Mech. 110(6): 930-936; 1984.

In this study, the writers used Tsai and Wu's tensor polynomial theory to rederive a formula originally derived by Cowin for shear strength variation in a plane of material symmetry of orthotropic materials. Experimental work was then performed (based on a method by Arcan, Hashin, and Voloshin) on Sitka spruce specimens to verify the formula. The theory and experiment agreed closely.

### **5. Shrinkage and Related Properties of Douglas-Fir Cell Walls**

Quirk, J. Thomas  
Wood Fiber Sci. 16(1): 115-133; 1984.

It is often desirable in veneer or particleboard operations, or in pulping, gluing and especially permeability studies, to use nondestructive sampling techniques to estimate specific gravity of wood behavior in situ.

Two separate optometric measuring techniques are compared for measuring anatomical parameters of intact, extractive-free wood directly. Excellent estimates of wood specific gravity in the green and oven-dry condition, cell-wall area, lumen area, cell-wall thickness, and density in situ are obtained by both methods. In addition, shrinkage in cell area, cell perimeter, tangential and radial dimensional shrinkage of cells, and volumetric shrinkage are obtained from measurements taken from the water-swollen to the oven-dry condition.

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## **buildings and construction**

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### **Structural Lumber: An Overview of Research Needs**

Galligan, William, L.; Green, David W.  
In: Itani, Rafik Y.; Faherty, Keith F., eds. Structural wood research: State-of-the-art and research needs: Proceedings of the workshop; 1983 October 5-6; Milwaukee, WI. New York: American Society of Civil Engineers; 1984: 3-27. (Complete proceedings available from American Society of Civil Engineers, 345 East 47th St., New York, NY 10017-2398; \$18 members, \$24 nonmembers.)

This paper provides an outline of the state-of-the-art of lumber properties and performance. The scope includes how properties are derived, as well as the environmental response of single, solid sawn members as viewed from an end-use perspective. As an introduction, the origin of lumber is reviewed, followed by design property assignment and assessment. The paper then proceeds to examine how both production processes and the use environment influence sawn lumber properties.

### **An Overview of Structural Panels and Structural Composite Products**

O'Halloran, M. R.; Youngquist, J. A.  
In: Itani, Rafik Y.; Faherty, Keith F., eds. Structural wood research: State-of-the-art and research needs: Proceedings of the workshop; 1983 October 5-6; Milwaukee, WI. New York: American Society of Civil Engineers; 1984: 133-147. (Complete proceedings available from American Society of Civil Engineers, 345 East 47th St., New York, NY 10017-2398; \$18 members, \$24 nonmembers.)

This paper reviews the technical state of the art of structural panel products. Other structural composites manufactured with the technology similar to that of structural panels will also be briefly considered. Research covering manufacturing technology has been omitted.

### **Determination of a Simplified Analytic/Test Procedure for Panel Product Acceptance**

Soltis, Lawrence A.  
Department of Housing and Urban Development Report HUD 0003173. 46 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$8.50; PB 84208412.)

Racking strength evaluations to determine acceptability of new panel products are currently based on relatively sophisticated tests. To reduce the cost of testing, preliminary estimates of racking strength of 8- by 8-foot panels are made from simplified lateral nail tests and analytic aids. The results of the lateral nail tests are corrected for the effects of three-versus two-member joints and method of loading. Acceptable predictions of wall racking tests are made.

### **Effects of Modeling Assumptions on Lateral Load Distribution in Low-Rise Timber Buildings**

Itani, Rafik; Soltis, Lawrence; Tuomi, Roger L.  
Department of Housing and Urban Development Report HUD 0003174. 23 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$7; PB 84208420.)

Windloads and seismic loads are generally apportioned to the lateral and vertical components of low-rise timber buildings according to tributary area. This report presents a model to determine the load distribution dependent on component stiffness and interaction. The results show the component interaction that is represented by joint stiffness is the predominant influence in how the load is distributed. The component stiffness is a secondary factor. Conclusions are then based on a sensitivity analysis of assumed joint stiffness.

### **Aids to Design of Low-Rise Buildings for Windloads**

Yancey, Charles W. C.; Soltis, Lawrence A.; Tuomi, Roger L.  
Department of Housing and Urban Development Report HUD 0003175. 65 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$10; PB 84208438.)

The prevailing standard in the United States for windload design of buildings is the American National Standards Institute (ANSI) Standard A 58.1. The two objectives of this report are: (1) to compare the provisions of the 1980 draft of ANSI A 58.1 to the 1972 edition and (2) to present design aids for computing horizontal windloads on one-, two-, and three-story rectangular buildings with gable roofs. This information will be useful in the structural design of frames, shear walls, and anchorage systems for low-rise timber buildings.

### **Correlating Seismic Forces and Wind Racking Forces**

Soltis, Lawrence A.  
Department of Housing and Urban Development Report HUD 0003176. 32 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$8.50; PB 84208446.)

Shear walls in light-frame timber buildings provide racking resistance to horizontal forces caused by wind or earthquake. This report summarizes seismic provisions of the Uniform Building Code and the American National Standards Institute and recommendations of the Applied Technology Council as they apply to the main frame resisting system of one-, two-, and three-story light-frame buildings.

The seismic forces are presented in a design aid normalized to the same parameters as wind forces presented in a companion report. Thus these design aids are used to determine seismic load and whether wind or seismic governs a particular design.

### **6. Deflections of Uniformly Loaded Floors: A Beam-Spring Analog**

McCutcheon, William J.  
USDA Forest Serv. Res. Pap. FPL 449; 1984. 15 p.

A new method for computing the performance of uniformly loaded wood floors is presented. The procedure presents a floor as a simple structure consisting of a beam supported by elastic springs. The method computes midspan joist deflections which are virtually identical to those obtained from a large-scale finite element program, but at a fraction of the computational effort. Also, computations agree very closely with laboratory results. A simple BASIC program is presented for implementing the procedure.



## 7. Racking Performance of Light-Frame Walls Sheathed on Two Sides

Patton-Mallory, Marcia; Gutkowski, Richard M.; Soltis, Lawrence A.  
USDA Forest Serv. Res. Pap. FPL 448; 1984. 16 p.

This study investigates length effects (aspect ratio) and additive nature of one-sided walls (sheathings and wood frame) to predict behavior of double-sided shear walls. A comparison is made between racking resistance of exterior-type wall panels, e.g. plywood and gypsum sheathing, and interior wall panels, e.g. gypsum both sides.

## Wood-Frame Construction—Do It Right!

Sherwood, Gerald E.; Percival, Donald H.  
Urbana-Champaign, IL: University of Illinois at Urbana-Champaign, Small Homes Council, Building Research Council; 1983; Technical Note 15. 12 p. (Available from Small Homes Council-Building Research Council, One East St. Mary's Road, Champaign, IL 61820; \$5.00 plus \$.50 postage and handling.)

This publication shows examples of common errors in wood-frame construction practices and explains acceptable principles and practices aimed at reducing future occurrences. It should be of use to building designers, builders, and homeowners.

## chemistry

## 8. Reactivity and Spectral Comparisons of Alkylresorcinol Laminating Resins with Phenolic and Resorcinolic Resins

Christiansen, A. W.  
Int. J. Adhesion Adhesives. 4(3): 109-119; 1984.

Two alkylresorcinol-based laminating resins, DFK-14R and FR-100, are compared in reactivity and structure with resorcinol- and phenol-based adhesive resins. The alkylresorcinols, derived from Estonian shale oil, replace costlier, less-reactive resorcinol in adhesives in the USSR. Differential scanning calorimetry quantitates the reactivity advantage.

## <sup>13</sup>C NMR Study of Curing in Furfuryl Alcohol Resins

Chuang, I-Ssuer; Maciel, Gary E.; Myers, George E.  
Macromolecules. 17(5): 1087-1090; 1984. (Available from Gary E. Maciel, Department of Chemistry, Colorado State University, Fort Collins, CO 80523. No charge.)

A <sup>13</sup>C CP/MAS NMR study of furfuryl alcohol resins is reported. A conformational rigidity is found for uncured or less cured resins. The contents of methylol groups and dimethylene ether linkages are found to be very small. It is postulated that cross-linking involves the breaking of methylene bridges in the curing process. Further confirmation is given that the major cross-linking processes that occur during curing involve linkages with bridging CH<sub>2</sub> groups, rather than substitution at the 3- and 4-positions of furan rings in the resins.

## 9. New Serratane Triterpenes from Western White Pine Bark

Conner, Anthony H.; Nagasampagi, Bhimsen A.; Rowe, John W.  
Tetrahedron. 40(21): 4217-4226; 1984.

Three new serratanes were isolated from the nonsaponifiable fraction of western white pine (*Pinus monticola* Dougl.) bark. The compounds were shown to be 3 $\beta$ -methoxyserrat-14-ene-21 $\alpha$ -30-diol (8a), 3 $\beta$ -methoxyserrat-14-ene-21 $\alpha$ -29-diol (9a), and 3 $\beta$ -methoxyserrat-14-ene-21 $\beta$ -30-diol (10a), by a combination of chemical, and spectral methods.

## 10. Reaction of Isocyanates with Southern Pine Wood to Improve Dimensional Stability and Decay Resistance

Ellis, W. Dale; Rowell, Roger M.  
Wood Fiber Sci. 16(3): 349-356; 1984.

Wood's biodegradability, flammability, changing dimensions with varying moisture contents, and degradability by ultraviolet light are all the result of chemical reactions involving degradative environmental agents. Reacting isocyanates with wood cell-wall polymers has the potential of improving some of these undesirable properties of wood by changing wood's basic chemistry.

This research was performed to determine the improvements in dimensional stability and decay resistance of wood through reaction with several aliphatic, aromatic, mono- and difunctional isocyanates.

## 11. Effects of C<sub>α</sub>-Oxidation in the Fungal Metabolism of Lignin

Fenn, Patrick; Kirk, T. Kent  
J. Wood Chem. Technol. 4(2): 131-148; 1984.

C<sub>α</sub>-Oxidation (benzyl alcohol oxidation) is a prominent reaction in the degradation of lignin by white-rot fungi. This study showed that such oxidation markedly retards metabolism of a nonphenolic  $\beta$ -O-4 model compound, 1-(3-methoxy-4-ethoxyphenyl)-2-(*o*-methoxyphenoxy)propane-1,3-diol, by cultures of *Phanerochaete chrysosporium* Burds.

## 12. Two-Stage, Dilute Sulfuric Acid Hydrolysis of Hardwood for Ethanol Production

Harris, John F.; Baker, Andrew J.; Zerbe, John I.  
In: Energy from biomass and wastes VIII: Symposium Papers; 1984 January 30-February 3; Lake Buena Vista, FL. Chicago, IL: Institute of Gas Technology; 1984: 1151-1170.

This is a synopsis of a large report soon to be released by the Forest Products Laboratory. The original report was developed in cooperation with the Tennessee Valley Authority. The report presents information on a two-stage, dilute acid hydrolysis process and its application to the production of ethanol from hardwoods.

## Raman Spectroscopy of Urea-Formaldehyde Resins and Model Compounds

Hill, Charles G., Jr.; Hedren, Alicia M.; Myers, George E.; Koutsky, James A.  
J. Appl. Polym. Sci. 29: 2749-2762; 1984. (Available from Charles G. Hill, Jr., Department of Chemical Engineering, University of Wisconsin, Madison, WI 53706. No charge.)

Laser Raman spectroscopy was used to analyze the structures of urea-formaldehyde resins. Band assignments were made on the basis of Raman studies of model compounds. Methylol and certain methylene functionalities could be differentiated in both the model compounds and the resins. Spectra of the resins at various stages of cure were also examined. Trends noted agreed with earlier studies on the kinetics and the proposed mechanism of the cure process. Laser Raman spectroscopy offers promise for elucidating the structures of urea-formaldehyde resins and for providing insight into the molecular phenomena of the cure and degradation of these resins.

## Toward the Development of a Biological Process for Removal of Color from Pulp and Paper Mill Effluents

Joyce, Thomas W.; Gerrard, Elizabeth D.; Campbell, Alton G., Jr.; Chang, Hou-min; Kirk, T. Kent  
In: Proceedings "The Impact of Energy and Environmental Concerns on Chemical Engineering in the Forest Products Industry October 30-November 4, 1983. AIChE Symp. Series 239(80): 86-89; 1984. (Complete proceedings available from American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017; members \$15, nonmembers \$30, prepaid.)

A biological color removal process for kraft chlorine bleach plant effluents utilizing the white-rot fungus *Phanerochaete chrysosporium* in a rotating biological contractor (RBC) is currently being developed by the Forest Products Laboratory and North Carolina State University as the FPL/NCSP MyCor (Mycelial Color Removal) process. Commercial application of the process has been delayed due to its short operational lifetime. Significant increases in the active fungal decolorization lifetime and total color removal capacity were observed with both biologically treated pulp and paper mill effluents and also with bleach plant effluent to which low levels of nitrogen had been added.

## 13. Anthraquinone Losses During Alkaline Pulping

Landucci, Lawrence, L.  
J. Wood Chem. Technol. 4(2): 149-161; 1984.

Extensive loss of AQ from the catalytic cycle during delignification has been explained by side reactions involving an AQ reduction product, and by the involvement of lignin quinone methides which lack beta-ether linkages.



#### 14. <sup>13</sup>C NMR Characterization of Soda and Soda/AQ Spent Liquor Fractions

Landucci, Lawrence L.  
J. Wood Chem. Technol. 4(2): 171-186; 1984.

Spent liquor fractions from soda and soda/anthraquinone cooks of loblolly pine wood meal were examined by <sup>13</sup>C NMR spectroscopy. The material which precipitated from the liquors at pH 7 as well as that remaining in solution were acetylated and fractionated on a styrene-divinylbenzene gel column. This technique was an attempt to simplify spectral interpretation and to elucidate the distribution of anthracenyl structures within the spent liquor components.

#### Solid-State <sup>13</sup>C NMR Study of Resol-Type Phenol-Formaldehyde Resins

Maciel, Gary E.; Chuang, I-Ssuer; Gollob, Lawrence  
Macromolecules 17(5): 1081-1087; 1984. (Available from Gary E. Maciel, Department of Chemistry, Colorado State University, Fort Collins, CO 80523. No charge.)

The <sup>13</sup>C NMR experiment with cross polarization (CP) and magic-angle spinning (MAS) provides valuable information on the structure and the curing process of the resol-type phenol-formaldehyde resins. Two major features revealed by this technique regarding the curing process of these resins are the extensive involvements of the hydroxyl group of phenols and condensation of methylene bridges with hydroxyl groups.

#### 15. An Analysis of the Wood Sugar Assay Using HPLC: A Comparison with Paper Chromatography

Pettersen, Roger C.; Schwandt, Virgil H.; Effland, Marilyn J.  
J. Chromatogr. Sci. 22: 478-484; 1984.

Liquid chromatography (LC) is a fast and efficient means of separating the five wood sugar residues (glucose, xylose, galactose, arabinose, and mannose) in neutral, aqueous solutions.

Although the LC method has been clearly demonstrated there are presently few quantitative data available concerning the analysis of wood and pulp samples. The authors present quantitative results from a variety of woods and wood pulps using both the LC method and the older, established method, paper chromatography (PC).

#### 16. Adducts of Anthrahydroquinone and Anthranol with Lignin Model Quinone Methides. 4. Proton NMR Hindered Rotation Studies. Correlation between Solution Conformations and X-ray Crystal Structure

Ralph, John; Landucci, Lawrence L.; Nicholson, Brian K.; Wilkins, Alistair L.  
J. Org. Chem. 49(18): 3337-3340; 1984.

The acetylated anthrahydroquinone/lignin model quinone methide adduct *threo*-1-(4-acetoxy-3-methoxyphenyl)-1-(9,10-dihydro-10-hydroxy-9-oxoanthracen-10-yl)-2-(2-methoxyphenoxy)propane (1) exhibits hindered rotation in the proton NMR spectrum near room temperature. The spectral dispersion of aromatic and methoxyl protons caused by substantial shielding effects allows a detailed conformational assignment. X-ray crystallography of 1 reveals that the molecule exists in the solid state in a conformation very similar to that proposed in solution and that the single conformer in the crystalline state is the same as the major (62%) solution-state rotamer.

#### 17. Reaction of Epoxides with Wood

Rowell, Roger M.; Ellis, W. Dale  
USDA Forest Serv. Res. Pap. FPL 451; 1984.

This report is a summary of an 8-year research program at the Forest Products Laboratory on chemical modification of wood with epoxides. Several species of wood were tested and the reactivity of many mono and difunctional epoxides was determined. The majority of the research concentrated on the reactions of propylene and butylene oxides catalyzed with triethylamine using southern pine.

#### 18. Hemicellulose Distribution in Pulp Fibers and Alkaline Extraction Rates

Scott, Ralph W.  
J. Wood Chem. Technol. 4(2): 199-218; 1984.

Hemicellulose molecules available for fiber-fiber bonding should also be among those most readily extracted by alkali. With this premise in mind the extraction rates of hemicellulose from chemical pulps were examined

and interpreted as being dependent on hemicellulose distribution. Measurements of the rates of extraction of glucuronoxylan and glucomannan from primarily southern pine oxygen pulps showed that the bulk of hemicellulose was not immediately available to extraction.

#### 19. Observations on the Physiological Mechanisms and Chemical Constituents of Induced Oleoresin Synthesis in *Pinus resinosa*

Wolter, Karl E.; Zinkel, Duane F.  
Can. J. For. Res. 14: 452-458; 1984.

The objectives of this research were (1) to examine the physiological parameters associated with oleoresin induction when paraquat is systemically applied to red pine, specifically, to describe response to treatment of such physiological functions as respiration, transpiration, ethylene production, photosynthesis, and moisture retention, (2) to verify that ethylene *per se* can induce oleoresin synthesis, and (3) to compare the chemical composition of the induced oleoresin with normal oleoresins.

### degradation and protection

#### 20. Edge Treatment Effects on Edge Degradation of Aspen Waferboard in Simulated Weathering

Carll, Charles G.  
In: Maloney, Thomas M., ed. Proceedings of the 17th Washington State University Particleboard/Composite Materials Series; 1983 March 29-31; Pullman, WA. [Pullman, WA]: Washington State University; 1983: 313-323.

This work identifies durability of waferboard edge integrity in short-term exterior exposure. A simulated weathering test procedure was employed. The effect of edge treatments (that retard pickup of liquid water) at protecting edge integrity was examined. Results suggest that edge treatments are not essential for protecting lateral nail resistance of waferboard used as sheathing, but may be of value for mitigating irreversible edge thickness swelling.

#### Replacement Wooden Frames and Sash: Protecting Woodwork Against Decay

Feist, William C.  
U.S. Department of the Interior, National Park Service, PTN-4; 1984. (Available from TECH NOTES, Preservation Assistance Division, National Park Service, P.O. Box 37127, Washington, DC 20013-7127. No charge.)

The field test conducted by the Forest Products Laboratory showed that there are safer treatments for protecting woodwork in northern climates than many commonly used. The combination of pretreating and painting provides good long-term protection against decay. Of equal interest, the test showed that there are effective ways to prevent decay in wooden window elements even where the windows are exposed to long periods of maintenance neglect.

#### 21. Protecting Piles from Decay; End Treatments

Highley, T. L.  
Int. J. Wood Preserv. 3(2): 73-76; 1983.

Millions of dollars are spent each year to replace decayed marine piling. The primary avenue of decay infection is through the ends where untreated wood is exposed after piles are cut off. Thus, several fungicides were evaluated for their ability to protect the top cutoff end of creosoted Douglas-fir piles from decay. Supplementary treatment with a 20 percent ammonium bifluoride solution or Osmoplastic provides at least 5 years of protection against decay in a high decay hazard climate. Pile tops treated with copper-8-quinolinolate, sodium borate, ammoniacal-copper-borate, sodium pentachlorophenate, and pentachlorophenol were decayed without a cap and, therefore, should only be used where a cap can be maintained.

#### 22. In-Place Treatments with Waterborne Preservatives for Control of Decay in Hardwoods and Softwoods Above Ground

Highley, Terry L.  
Material Organism. 19(2): 95-104; 1984.



The waterborne fungicides sodium borate, copper-8-quinolinolate, ammonium bifluoride, ammoniacal copper borate, and four quaternary ammonium compounds were compared to sodium pentachlorophenate as brush treatments for protection of southern pine, Douglas-fir, sugar maple, and red oak against decay above ground. After 5 years, of the untreated controls only maple and pine cross-brace units at the Gulfport, Mississippi, site and maple units at the Madison, Wisconsin, site were sufficiently decayed to evaluate effectiveness of treatments. Only ammonium bifluoride and ammoniacal copper borate continued to protect maple from decay in Mississippi, but all treatments except sodium borate and copper-8-quinolinolate are effective on pine. At Madison, maple cross-brace units treated with sodium pentachlorophenate, copper-8-quinolinolate, ammonium bifluoride, and ammoniacal copper borate are free of decay at 5 years.

### **23. Marine Exposure of Preservative-Treated Small Wood Panels**

Johnson, Bruce R.; Gutzmer, David I.  
USDA Forest Serv. Res. Note FPL-0248; 1984.

Small wood panels treated with many different chemicals have been exposed to limnorian and teredine marine borers in the sea at Key West, FL. These preservatives and treatments include creosotes with and without modification, waterborne salts, salt-creosote dual treatments, chemical modifications of wood, and modified polymers.

### **24. Effect of Wood Preservative Treatment of Beehives on Honey Bees and Hive Products**

Kalnins, Martins A.; Detroy, Benjamin F.  
J. Agric. Food Chem. 32(5): 1176-1180; 1984.

The objectives of this study were to determine which of several treatments for beehives are harmless to bees and if any of the preservative chemicals accumulate in the bees, honey, or wax.

### **25. Fungi and Decay in Western Redcedar Utility Poles**

Scheffer, Theodore C.; Goodell, Barry S.; Lombard, Frances F.  
Wood Fiber Sci. 16(4): 543-548; 1984.

Three decay fungi were isolated from the heartwood and six from the sapwood of western redcedar poles. None had previously been reported in poles of this species in North America. There was little radial extension of heartwood infection beyond the advanced decay.

### **26. Precipitation of CCA Solutions for Waste Disposal**

Winandy, Jerrold E.  
Int. J. Wood Preserv. 3(2): 83-88; 1983.

Chromated copper arsenate (CCA) wood-treating solutions are infrequently re-used and are often disposed of by many pilot-plant operations and by most research laboratories. Disposal of CCA is difficult and expensive. This paper discusses laboratory precipitation treatments to facilitate separation of toxic waste water into an easily contained toxic solid and a nontoxic effluent. Two distinct types of processes were considered—primary processes to induce precipitation and subsequent secondary processes. The most effective system developed used a combination of wood sawdust, hydrogen peroxide, and charcoal filtration. Hydrogen peroxide alone was an extremely fast system and sawdust alone was an extremely effective system in precipitating chromium, copper and arsenic from solution.

## **design data**

### **27. Thermal and Moisture Behavior of an Envelope Test Building**

Converse, A. O.; Hans, G.; Sorensen, A.  
In: Thermal performance of the exterior envelopes of buildings II: Proceedings of the ASHRAE/DOE conference; 1982 December 6-9; Las Vegas, NV. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers. 895-912; 1983.

The double-envelope design may offer some unusual thermal performance advantages in wood-frame house construction, but its basic performance aspects, such as convective looping and ground coupling for heat distribution and storage, still are not adequately understood.

This study was conducted to gain a better understanding of the effects of ground coupling on convective loop flow, heat balance, and degradation hazards. Data were obtained from a room-size outdoor test structure in New England which was monitored for the 1981-1982 heating season.

### **28. Estimating the Correlation Between Variables Under Destructive Testing, or How to Break the Same Board Twice**

Evans, James W.; Johnson, Richard A.; Green, David W.  
Technometrics. 26(3): 285-290; 1984.

A procedure is described for estimating the correlation between two variables that, individually, can only be observed through destructive testing. The procedure involves proof loading a unit in one failure mode and then failing survivors in the other mode. Under the assumption that the variables have a bivariate normal distribution, several properties of the estimation procedure are evaluated using simulation. Primary results provide guidance concerning the experimental design aspect of selecting a proof-load level.

### **29. Strength and Stiffness Analysis of Notched, Green Oak Pallet Stringers**

Gerhardt, Terry D.  
USDA Forest Serv. Res. Pap. FPL 452; 1984.

Methodology is developed that determines stiffness and strength reductions caused by notches in pallet stringers. A finite element (FE) structural model is developed to model notched stringers. Displacement and stress predictions agree well with experimental measurements. The author derived closed form equations that approximate FE displacements and maximum stresses as functions of notch depth. The stiffness equations are based on modeling the stringer with beam elements of an 'equivalent' geometry.

### **30. Investigation of the Procedure for Estimating Concomitance of Lumber Strength Properties**

Green, David W.; Evans, James W.; Johnson, Richard A.  
Wood Fiber Sci. 16(3): 426-440; 1984.

An analytical method that utilizes information generated through proofloading to estimate the correlation between lumber strength properties is reviewed. A computer simulation was conducted to determine the effects of sample size and proofload level and also the degree of true correlation between lumber properties on the estimates of the correlation coefficient. Results indicate that reasonable estimates of the correlation coefficient can be obtained using sample sizes of 100 or more with a minimum proofload that would be expected to break 40 percent (proofload level = 0.40) of the specimens tested. Additional studies are suggested, however, before the technique is used.

### **Structural Analysis of Light-Frame Subassemblies**

Gromala, David S.; Wheat, Dan L.  
In: Itani, Rafik Y.; Faherty, Keith F., eds. Structural wood research: State-of-the-Art and research needs: Proceedings of the workshop; 1983 October 5-6; Milwaukee, WI. New York: American Society of Civil Engineers; 1984: 73-105. (Complete proceedings available from American Society of Civil Engineers, 345 East 47th St., New York, NY 10017-2398; members \$18, nonmembers \$24.)

This paper reviews research from the 1950's and 1960's on load transfer mechanisms and shows how this work has formed the basis of the subassembly models of the 1970's and 1980's. Emphasis is specifically directed toward analytical methods that account for load transfer between elements in subassemblies.

### **31. New Shear Strength Test For Solid Wood**

Liu, J. Y.  
Wood Fiber Sci. 16(4): 567-574; 1984.

A new method for testing material properties has been applied to determine the shear strengths of specimens of Sitka spruce and Douglas-fir. The method permits the realization of pure shear in the critical section of the specimen. Pure shear is not achieved in the current American Society for Testing and Materials (ASTM) shear test. The large strength ranges of wood fibers and the vast differences in strength between earlywood and latewood fibers can still cause significant scatter in the test data, but the effect of combined stresses can be effectively controlled. The new method can yield only shear strength parallel to grain, which is required for engineering design purposes.



### **32. The Influence of Moisture Content on the Flexural Properties of Southern Pine Dimension Lumber**

McLain, T. E.; DeBonis, A. L.; Green, D. W.; Wilson, F. J.; Link, C. L.  
USDA Forest Serv. Res. Pap. FPL 447; 1984. 40 p.

This paper presents the experimental results of a program to evaluate the effect of moisture content on the flexural properties of Southern Pine dimension lumber. This study was initiated because of discrepancies between currently accepted design standards and recent research evidence.

### **33. Lateral-Torsional Response of Low-Rise Timber Buildings**

Naik, T. R.; Kaliszky, S.; Soltis, L. A.  
In: Proceedings of the Eighth World Conference on Earthquake Engineering; Vol. 4. Response of Structures. 1984 July 21-28; San Francisco, CA. Englewood Cliffs, NJ: Prentice Hall, Inc.; 1984: 663-670.

Knowing the combined lateral and torsional response of a light-frame timber structure is important for seismic design. A three-dimensional model is developed to determine the coupled lateral and torsional natural frequencies and mode shapes for low-rise timber buildings with shear wall and diaphragm construction. Results are presented for a two-story building common to residential construction in the United States.

### **Contribution of Gypsum Wallboard to Racking Resistance of Light-Frame Walls**

Wolfe, Ronald W.  
Department of Housing and Urban Development Report HUD 0003170. 100 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$13; PB 84208388.)

Forty light-frame walls were tested to characterize the contribution of gypsum wallboard to racking performance of shear walls. Variables studied included windbracing, wall length, corner connections, openings, and wallboard orientation. Wallboard and windbracing were found to interact as parallel elements. The relationship between racking resistance and wall length was nonlinear for continuous wallboard diaphragms and varied with deformation level. Corner connections and wallboard orientation had a significant effect on strength and stiffness, and the uninterrupted wall length provides good correlation to wall strength for walls with openings.

Results of this study provide a basis for engineers and code authorities to judge the contribution of gypsum wallboard to the shear resistance of walls under windloads and seismic loads. Results will also be useful in planning future research for light-frame construction.

### **Effect of Uplift Restraint in Wall Racking Tests**

Wolfe, Ronald W.  
Department of Housing and Urban Development Report HUD 0003171. 53 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$10; PB 84208396.)

This study was conducted to compare three potential alternatives to the current ASTM Standard E 72 holdown device and to recommend one to be used with ASTM Standard E 564 for testing walls sheathed with gypsum wallboard. Criteria included: (1) influence on wall performance, (2) variability of test results, and (3) ease of application.

Results support acceptance of a cable holdown for use with gypsum-sheathed walls and further development of a hinge mechanism as a standard test holdown. A third mechanism using a steel strap was rejected due to test damage making it nonreusable. This information is of interest to those concerned with the evaluation of light-frame wall performance.

### **Racking Performance of Plywood-Over-Foam-Insulation Wall Construction**

Wolfe, Ronald W.  
Department of Housing and Urban Development Report HUD 0003172. 31 p. Written in 1982. (Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161; \$8.50; PB 84208404.)

Tests described in this report were conducted to provide preliminary information on the racking performance of light-frame walls containing plywood-siding-over-foam insulation used in combination with gypsum wallboard interior sheathing.

### **34. Bracing Requirements for Lateral Stability**

Zahn, John J.  
J. Struct. Eng. 110(8): 1786-1802; 1984.

The forces induced in braces depend on the magnitude of initial imperfections (lateral bending and twist) and magnitude of applied loads. A method for calculating these forces is presented here. Shear stiffness of the attached deck is taken into account. Calculations show that, for beams which derive their lateral stability mainly from the stiffness of the attached deck, additional bracing against rotation or lateral deflection is not able to achieve an important increase in the load capacity of the systems.

## **economics**

### **35. Edge in Fuel Costs Leads to Greater Wood Burning**

Bailey, Mark; Skog, Ken  
In: Hayes, Jack, ed. Using our natural resources: 1983 yearbook of agriculture, Washington, DC: U.S. Department of Agriculture. (Complete book available from GPO Main Bookstore, 710 N. Capitol St., Washington, DC 20402; \$7.)

The authors discuss the use of wood as a fuel and the economics of such a use.

### **Employment in Minnesota's Wood-Based Industry: A Shift-Share Analysis**

Bilek, Edward M.; Ellefson, Paul V.  
Staff Paper Series 46. College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN; 1984. (Available from College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN 55108. No charge.)

This analysis focuses on employment in Minnesota's wood-based industries compared with wood-based industries in entire country.

Despite industry shift to the South, the Minnesota wood-based employment grew, and the wood-based industry in Minnesota is a growth industry.

### **Concepts Used in a Regionalized Model of Pulp and Paper Production and Trade**

Buongiorno, Joseph; Gilles, James K.  
University of Wisconsin, Department of Forestry, Madison, WI. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

This paper outlines the structure and underlying concepts of a model of the pulp and paper sector to be used in the 1985 U.S. Forest Service Timber Assessment. This multi-regional partial equilibrium model is designed to calculate equilibrium prices and quantities in the various regions during each year of the projection period. The model combines econometric estimates of all final demand and some supply relationships with a detailed input-output representation of technological processes in the regions of major interest.

### **36. Forecasting the Price of Lumber and Plywood: Econometric Model Versus Futures Markets**

Buongiorno, Joseph; Huang, F. Mey; Spelter, Henry  
Forest Prod. J. 34(7/8): 13-18; 1984.

Three methods of forecasting the price of lumber and plywood are compared: 1) the FORSIM model of Data Resources Inc., 2) the futures markets, with prices of contracts for future delivery used as forecasts of cash prices, and 3) a naive model where the predicted price is equal to the last known cash price. The comparisons used data for the period 1974 to 1981. For lumber forecasts of the current quarter and one quarter ahead there was no significant difference in accuracy between the FORSIM and futures market. For two and three quarters ahead, FORSIM was better. For all horizons, FORSIM and the futures market were more accurate than the naive model.



## **U.S. Wood-Based Industry**

Ellefson, Paul V.; Stone, Robert N.  
New York: Praeger Publishers; 1984. 479 p. (Available from Praeger Publishers, 521 Fifth Ave., New York, NY 10175; \$43.95.)

The manner in which the U.S. wood-based industry is organized, how its business activities are conducted, and its success are measured by various indicators of performance. The authors present a broad picture of the U.S. industrial landscape and the role forests and wood processing activities play in the U.S. economy.

## **An Interregional Analysis of the North American Newsprint Industry**

Guder, Faruk; Buongiorno, Joseph  
Interfaces. 14(5): 85-89; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

An interregional analysis of the newsprint industry in the United States and Canada was performed in order to develop a model that would represent accurately the behavior of the industry in terms of regional demand, supply, prices, and transportation of newsprint and attendant raw materials. This model was used to make long-term projections of newsprint production, consumption, manufacturing capacity, and prices based on a specific scenario for future economic and demographic growth. These kinds of forecasts are useful in long-term strategic planning to help firms foresee the evolution of the markets within which they operate.

## **Dealing With Uncertainty in USDA Forest Service Planning**

Hite, Michael P.; Hewett, Charles E.  
Hanover, NH: Resource Policy Center, Dartmouth College; 1983; RP-504 76 pp. (Available from Resource Policy Center, Dartmouth College, Box 8000, Hanover, NH 03755. \$6.25.)

This paper demonstrates the potential role of incorporating uncertainty into policy analyses for the formulation of Forest Service policies and programs. The implications of uncertainty in this process are considered and show how dealing with uncertainties can assist the Forest Service in looking at options from a broader perspective. The authors look at the uncertainties that cloud Forest Service projections as well as those of others, the inherent uncertainties in the evolution of the political, economic, and social environments, and the uncertain interactions among Forest Service policies and programs.

## **37. Pulp and Paper Science May Change Technology and Increase Use of Southern Hardwoods**

Ince, Peter  
In: Guldin, Richard W., ed. Payoffs from new techniques for managing and processing southern hardwoods: Proceedings of the 1984 Southern Forest Economics Workshop; 1984 March 13-15; Memphis, TN. Raleigh, NC: SOFEW Proceedings; 1984: 71-86.

This report also analyzes historical roles of technology and economic change in increasing the use of hardwood pulpwood. Increased use of hardwood pulpwood in the United States has risen out of technological and economic changes. Over the past 30 years, technological change doubled the ratio of hardwood in all pulpwood consumed in the South, and the United States as a whole. Over the same period, economic change more than tripled total consumption of all pulpwood in the United States, and nearly quadrupled pulpwood consumption in the South.

## **38. Computer Model for Economic Study of Unbleached Kraft Paperboard Production**

Ince, Peter J.  
USDA Forest Serv. Gen. Tech. Rep. FPL 42; 1984.

Unbleached kraft paperboard is produced from wood fiber in an industrial papermaking process. A highly specific and detailed model of the process is presented. The model is also presented as a working computer program. A user of the computer program will provide data on physical parameters of the process and on prices of material inputs and outputs. The program is then used to calculate material and energy requirements of the process, and to calculate related revenues and variable costs.

## **39. Economics of Increasing the Use of Recycled Fiber in Linerboard**

Ince, Peter J.; Klungness, John H.  
Tappi J. 67(8): 62-65; 1984.

This report finds economic advantages in using more recycled corrugated in kraft linerboard compared to the alternative of expanding pulping capacity. Results show the economic incentives for research and development of processes which will permit increased use of recycled fiber in linerboard such as for example the wide-lip disk separator.

## **40. Revolution on the Farm Woodlot—Low Grading**

Koning, John W. Jr.  
Woodland Manage. 5(2): 8-9; 1984.

The establishment of wood co-ops for the consolidation, storage, and shipment of whole tree chips can provide an economic outlet for the presently under-utilized wood on our nation's farm woodlots.

## **41. Residential Fuelwood Use in the United States**

Skog, Kenneth E.; Watterson, Irene A.  
J. Forestry. 82(12): 742-747; 1984.

This article draws on survey results to answer several questions. What is the new magnitude of fuelwood consumption? Where are the locations of heavy use? What is the drain on growing stock and nongrowing stock timber? How do purchased fuelwood amounts and prices, and amounts cut by households, compare to pulpwood production and prices? What is the contribution of wood in displacing conventional fuels? What will be the effect of further increases in conventional fuel prices, particularly natural gas, on fuelwood demand?

## **42. Price Elasticities for Softwood Plywood and Structural Particleboard in the United States**

Spelter, Henry  
Can. J. For. Res. 14(4): 528-535; 1984.

A multiequation model analyzing the price elasticities for construction panels (softwood plywood and structural particleboard) was developed. The response of softwood plywood demand to price was found to have declined substantially over the 30-year span of analysis, dropping from an estimated 0.83 in 1950 to 0.10 in 1981. The price elasticity of structural particleboard, by contrast, was estimated at substantially higher levels in the late 1970's. The model results indicate the demand for structural particleboards is highly sensitive to price, and pricing will be a key variable determining its growth.

## **43. New Products—A Review of the Past and A Future Analysis**

Stone, Robert N.  
In: The Hardwood Lumber Industry From Producer to User: Proceedings. Symposium 1982 September 16-18; East Lansing, MI. [East Lansing, MI]: Michigan State University. [1984]: p. 26-28.

The author looks at long-term trends to identify change factors influencing the hardwood lumber industry, and then provides perspective on the future by analyzing and extrapolating these change makers.

## **fire**

## **44. Smoke Accumulation 2. Predictive Parameters for Plywood**

Brenden, John J.; LeVan, Susan L.  
J. Fire Sciences. 2(4): 276-285; 1984.

In this study, a specially modified chamber facilitated smoke sampling at several locations. Sampling at various locations established the smoke distribution and made it possible to calculate correlating parameters using 3/8-inch (0.953 cm) thick Douglas-fir plywood. In general, the particulate optical density (POD), the mass optical density (MOD), and the weight fraction ( $\chi$ ) of particulates in the smoke showed considerable variability.



#### 45. Structural Fire Design: Wood

Schaffer, E. L.

USDA Forest Serv. Res. Pap. FPL 450; 1984. 16 p.

This paper summarizes the data base related to the deterministic prediction and measurement of the fire endurance of heavy timber members. For testing the accuracy of analytical models, the characteristic loading conditions and actual fire endurance times of members are needed. This is done for each member type.

#### 46. Replicate Fire Endurance Tests of an Unprotected Wood Joist Floor Assembly

White, Robert H.; Schaffer, E. L.; Woeste, F. E.  
Wood Fiber Sci. 16(3): 374-390; 1984.

The aim of this study was to determine the fire endurance of a conventional light-frame unprotected floor and to use this information in a probabilistically based predictive model. Information on the variability of the fire endurance of the full-scale floor specimens and the mechanical properties of the joists used in the floor specimens was required for verification of the model. The reliability analysis model of Woeste and Schaffer (1979, 1981) evaluates the probability of structural failure of the floor. This research report covers the experimental results of the fire tests. Comparison of the experimental results with the predictions of the model will be covered in a future paper.

### general

#### Microcomputer Program for Random Selection of Board Samples from Stacked Lumber

Bozaan, D.; Ramm, C. W.; Beauregard, M. J.  
Forest Prod. J. 34(2): 51-52; 1984. (Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705; \$2 each, with \$5 minimum, plus 10% postage and handling.)

This report discusses a technique for randomly selecting samples from a large lumber stack, using a microcomputer.

#### Tropical Timbers of the World

Chudnoff, Martin

Agric. Handb. 607 Washington, DC: U.S. Department of Agriculture, Forest Service; 1984. 466 p. (Available from Superintendent of Documents, U.S. Government Printing Office, 710 N. Capitol Street, Washington, DC 20402; \$16; 001-001-00607-6.)

This handbook contains descriptions of 370 species or generic groupings of tropical trees and their timbers grouped by regional origin: Tropical America, Africa, and Southeast Asia and Oceania. Standardized descriptions emphasize physical and mechanical properties, processing characteristics, and uses. Data have been compiled, evaluated, and synthesized from the world literature. Extensive tables of technical data are coded to permit easy comparison of species properties and to aid in the selection of woods most suitable for particular end uses.

#### 47. Jari's Successes

Hornick, John R.; Zerbe, John I.; Whitmore, Jacob L.  
J. For. 82(11): 663-667; 1984.

The authors discuss the Jari project which is an experiment to make plantation forestry profitable on a large scale in the Amazon River Basin.

#### Housing and Wood Products Assessment: Final Report

Lewis, Philip H., Jr.; Lamm, W. Thomas; Martin Vine, Vicki K.; Kaufman, Harry F.; Marcini, Thomas C.  
Submitted to Congress of the United States, Office of Technology Assessment, December 10, 1982; The Environmental Awareness Center, University of Wisconsin-Extension. (Available from U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; \$19; ADA 144 434.)

Some changes are pulling the housing industry in different directions, while the effects of others are compounded. This report attempts to describe the many areas affecting housing needs and to delineate their resultant impact on wood types and amounts needed for future housing.

#### Juvenile Wood: Processing and Structural Products Considerations

Senft, John F.; Bendtsen, B. Alan

In: Utilization of the changing wood resource in the southern United States: Proceedings of a symposium; 1984 June 12-13; Raleigh, NC: North Carolina State University; 1984. p. 102-108. (Complete proceedings available from North Carolina State University, Division for Lifelong Education, Box 7401, Raleigh, NC 27695-7401. ATTN: Alice Strickland/Gertha Heggie; \$13.)

Juvenile wood is defined as wood formed early in the life of a tree, usually including the first 8 to 20 annual growth increments. It occurs in both softwoods and hardwoods. The purpose of this paper is to point out and discuss the potential problems arising from the use of increased amounts of juvenile wood in products, primarily those whose use depends upon strength and/or dimensional stability.

#### The Challenges of Utilizing the Changing Wood Resource of the South

Youngs, R. L.; Erickson, John R.

In: Utilization of the changing wood resource in the southern United States: Proceedings of a symposium; 1984 June 12-13; Raleigh, NC: North Carolina State University; 1984: 53-63. (Complete proceedings available from North Carolina State University, Division for Lifelong Education, Box 7401, Raleigh, NC 27695-7401. ATTN: Alice Strickland/Gertha Heggie; \$13.)

Shorter rotation ages have become common in the forests of the South. The use of younger trees will require continued attention to juvenile wood and related properties. Also, there is a need to find uses for mixed hardwoods in the South to improve forest management.

### mycology

#### 48. Adapting Liquid Spawn *Lentinus Edodes* to Oak Wood

Leatham, G. F.; Griffin, T. J.

Appl. Microbiol. Biotechnol. 20: 360-363; 1984.

*Lentinus edodes* (Berk.) Sing. is a commercially important edible mushroom cultivated on oak (*Quercus* spp.) logs or wood particles. This study shows that an aqueous extract of the oak wood is inhibitory to growth. Inoculum produced by homogenizing stationary-grown cultures was particularly sensitive to the extract. Three different methods decreased the sensitivity of inoculum: (1) use of intact (nonhomogenized) cultures as inoculum, (2) use of homogenized cultures produced from shaken rather than stationary cultures as inoculum, or (3) use of cultures grown in the presence of wood extract as inoculum.

#### Description and Identification of Selected Mycorrhizae in Pure Culture

Miller, O. K., Jr.; Miller, S. L.; Palmer, J. G.  
Mycotaxon 18(2): 457-481; 1983. (Available from O. K. Miller, Jr., Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. No charge.)

Fourteen species of ectomycorrhizal fungi were grown and described in pure culture. Two selective media and three chemical spot tests were used to separate the fungal taxa with a laccase extracellular enzyme system from those which have none or produce tyrosinase. Eleven stains were employed to differentially stain cell walls, protoplasmic contents, and lipoidal material in order to further characterize individual species. In addition, mycelia were scanned with UV light to record those that fluoresced. Lastly, pigmentation, smell, and total macro- and microscopic characteristics were recorded for each species. Using this set of characteristics it was possible to distinguish all of the taxa, and a key to the species based upon these characteristics as recorded on day 30 at 25°C is provided.

#### 49. *Merulius*, A Synonym of *Phlebia*

Nakasone, K. K.; Burdsall, H. H., Jr.  
Mycotaxon. 21: 241-246; 1984.

*Merulius* Fr. is placed in synonymy with *Phlebia* Fr. Supporting evidence from basidiocarp and culture studies are presented. The new combinations *Phlebia tremellosus* and *Phlebia incarnata* are proposed.



## **50. Observations of Wall-less Protoplasm in White- and Brown-Rot Fungi**

Palmer, John G.; Murmanis, Lidija; Highley, Terry L. *Mater. Organism.* 19(1): 39-48; 1984.

While studying the occurrence of hyphal sheaths in several brown- and white-rot Hymenomycetes on a variety of substrates we encountered a phenomenon that we have not seen reported in the literature, i.e. wall-less hyphal protoplasmic material in which hyphae with intact walls were embedded. The purpose of this report is to document the phenomenon, to present some information about its origin, and to speculate about its function in the process of wood decay.

## **packaging**

### **Edgewise Compression Creep of Fiberboard Components in a Cyclic-Relative-Humidity Environment**

Byrd, Von L. *Tappi J.* 67(7): 86-90; 1984. (Available from Information Services Division, Kurt F. Wendt Library, College of Engineering, University of Wisconsin-Madison, 215 North Randall Avenue, Madison, WI 53706; \$5.)

Creep tests of corrugated fiberboard prior to this study, done with short column-specimens made from virgin, high-yield, and recycled pulps, do not show whether the increased creep rate under cyclic RH is a property of the assembly or of its components.

This cyclic-RH study of creep response of components (linerboard and corrugating medium), compared with the earlier tests of combined board, reveals that corrugated fiberboards creep 2-5 times faster than the component measurements would indicate. Component creep tests were also run on two other materials that new technology has made relevant: conventionally dried, normal-yield, oak linerboard and press-dried, high-yield, oak linerboard.

## **processing**

### **Obtaining Uniform Final Moisture Content in the High Temperature Drying of Paper Birch Flitches.**

Erickson, R. W.; Petersen, H. D.; Larson, T. D. *Forest Prod. J.* 34(2): 27-32; 1984. (Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705, \$2 each, with \$5 minimum, plus 10% postage and handling.)

This report discusses a method of drying paper birch lumber at high temperature (212°F) to get uniformly dried wood.

### **51. Commercial Evaluation of SDR (Saw-Dry-Rip)—Using Aspen for Door Parts**

Huber, Henry; Maeglin, Robert R.; Bozaan, David *Forest Prod. J.* 34(11/12): 35-39; 1984.

This study evaluates the potential of the Saw-Dry-Rip (SDR) process (live-sawing and kiln-drying) for producing stiles and rails for flush doors from aspen. The setting is a large-scale manufacturing plant in Grayling, Mich. Three major warp parameters—crook, bow, and twist—are measured to determine if SDR significantly reduces warp in 5/4 aspen lumber.

### **52. In-Kiln Moisture Monitoring Systems**

James, William L.; Boone, R. Sidney  
In: Robertson, Doris, coord. Computer automation for sawmill profit: Proceedings 7333; 1982 October 4-6; Norfolk, VA. Madison, WI: Forest Prod. Res. Soc.; 1984: 91-94.

Efficient, automatic, control of a lumber dry kiln requires continual measurement of the moisture condition of the lumber being dried.

This report describes two systems that can provide continuous estimates of the moisture content (MC) of representative samples of the kiln load as it dries. Different parts of the load may be sampled to infer moisture distribution.

The first system indicates MC from a measurement of the dielectric properties of the load, using a simple sheet metal electrode placed in the load between two adjacent stickers.

The second system indicates changes in MC by measured changes in the speed of sound through a sample piece of lumber in the load.

### **53. Moisture Levels and Gradients in Commercial Softwood Dimension Lumber Shortly After Kiln-Drying**

James, William L.; Choong, Elvin T.; Arganbright, Donald G.; Doucet, D. K.; Gorvad, M. R.; Galligan, William L.; Simpson, William T. *Forest Prod. J.* 34(11/12): 59-64; 1984.

This study is an attempt to determine the moisture levels and residual MC gradients that are typical of commercial softwood dimension lumber soon after kiln-drying. Such information can help the inspection of lumber for compliance with MC grade requirements, using electric moisture meters, to be more reliable.

### **Saw-Dry-Rip Processing: Taking the Crook Out of the Stud Game**

Larson, T.; Erickson, R. W.; Petersen, H. D.  
In: Proceedings Joint Meeting Western Dry Kiln Clubs and PNW Section FPRS; 1983 May 4-6; Corvallis, OR. (Complete proceedings available from Western Dry Kiln Clubs, School of Forestry, Oregon State University, Corvallis, OR 97331. \$8.)

This report discusses the use of Saw-Dry-Rip (SDR) for producing studs from paper birch.

### **SDR—Red Alder Anyone?**

Layton, T. F.; Smith, W. R.  
In: Proceedings Joint Meeting Western Dry Kiln Clubs and PNW Section FPRS; 1983 May 4-6; Corvallis, OR. (Complete proceedings available from Western Dry Kiln Clubs, School of Forestry, Oregon State University, Corvallis, OR 97331. \$8.)

This report discusses the use of Saw-Dry-Rip (SDR) for producing studs from red alder.

### **54. Quality Recognition for Grading**

McDonald, Kent A.  
In: Robertson, Doris, coord. Computer automation for sawmill profit: Proceedings 7333; 1982 October 4-6; Norfolk, VA. Madison, WI: Forest Prod. Res. Soc.; 1984: 100-103.

This paper presents an overview of the application of quality recognition techniques potentially suited for automated lumber grading systems. To be successful, automated lumber grading systems have to sense and locate every existing grading criteria; otherwise, the criteria will have to be adapted to the limitations of the automated techniques.

### **55. Maintaining Lumber Quality in Press Drying by Manipulating Sawing Patterns**

Simpson, William T. *Wood Fiber Sci.* 16(3): 411-426; 1984.

Press drying can dry common 25-mm-thick lumber in 1 to 2 hours instead of several weeks. However, little success has been achieved with this technique because intolerable drying defects usually accompany such rapid drying. This paper reports on a press-drying technique that offers considerable promise in avoiding honeycomb that usually develops. In this technique the sawing pattern of boards from logs is changed from the usual flatsawn pattern to quartersawn.

### **56. Mechanism of Crook Development in Lumber During Drying**

Simpson, William T.; Gerhardt, Terry D. *Wood Fiber Sci.* 16(4): 523-536; 1984.

Crook can cause yield and grade loss in lumber. In this study the mechanism of crook was studied so that a better understanding might lead to methods for minimizing its development. Crook was observed to begin at an average moisture content of about 50%, and then to increase linearly as moisture content decreases. Differential longitudinal shrinkage on opposite edges of boards is shown to be the cause of crook. A model was developed to predict crook from differential longitudinal shrinkage, and experimental results agree with model predictions. The model was extended so that estimates can be made of the restraining force necessary to prevent crook.



## **57. Influence of Wetwood on Pulsed-Current Resistances in Lumber Before and During Kiln-Drying**

Ward, James C.

Wood Fiber Sci. 16(4): 598-617; 1984.

Measurements of resistance to a pulsed electric current were lower in wetwood of aspen (*Populus tremuloides*) and white fir (*Abies concolor*) than in normal wood—i.e., sapwood and heartwood—both before and during kiln-drying.

An exploratory investigation was initiated at the Forest Products Laboratory to determine how the presence of wetwood in lumber might influence measurements of resistance to a pulsed electric current during kiln-drying.

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## **pulp and paper**

### **Predicting the Biaxial Strength of Paperboard—A Mechanistic Approach**

Gunderson, Dennis E.; Bendtsen, Lee A.

In: Proceedings, 1984 TAPPI-STFI Paper Physics Seminar; 1984 June 25-29; Stockholm. Stockholm: Swedish Forest Products Laboratory; 1984: 99-109. (Available from libraries.)

This work has demonstrated that biaxial stress conditions exist in loaded fiberboard containers and are of considerable practical significance in the shipping environment. Methods have been developed for measuring biaxial strength and elastic properties, and the suitability of various theories for predicting biaxial strength have been evaluated.

### **Dimensional Property Measurements**

Setterholm, Vance C.

In: Mark, Richard E., ed. Handbook of physical and mechanical testing of paper and paperboard: Vol. 2. New York: Marcel Dekker, Inc.; 1984: 403-414. (Complete book available from Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016.)

The author discusses the use of dimensional property measurements in testing paper and paperboard toward improving their performance and utility.

## **58. Press-Dried Paper**

Setterholm, V. C.; Koning, J. W., Jr.

Appita. 37(5): 361-365; 1984.

The authors discuss recent work which has been carried out at the Forest Products Laboratory on the benefits of press-dried paper.

## **59. How Wet Press Residence Affects Paperboard Strength**

Wegner, T. H.; Caulfield, D. F.; Young, T. L.

South. Pulp Paper. 47(7): 18-22; 1984.

The paper industry continues to develop new procedures for removing more water in the wet press section of the paper machine. However, little information is available to guide the papermaker in exploiting these new wet-processing developments. This article aims to provide needed information on how nip residence time and press pressure interact to affect sheet strength, whether pressing at multiple, short nip residence times results in sheets of equal strength to those pressed at one long nip residence time, and whether sheets made from a fully-cooked hardwood kraft pulp can achieve equivalent strength of sheets made from a softwood kraft pulp.



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**NEW ITEM:**

**60. Identifying White Oak Logs With Sodium Nitrite**

Miller, Regis B.; Quirk, J. Thomas; Christensen, Donna J.  
Forest Prod. J. 35(2): 33-38; 1985.

The aim of this study was to establish a simple, reliable test that officials could use at ports of unloading to distinguish white oak logs from other species, particularly red oak.



U.S. DEPARTMENT OF AGRICULTURE  
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